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INTEGRATING ALLOCATION AND
STABILIZATION BUDGETS

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MIT. Paper prepared for the conference "Modern Public Finance" in honor of George Break, Richard Musgrave, and the memory of Joseph Pechman. This paper draws heavily on my ongoing research collaborations with Olivier Blanchard and Jim Mirrlees. I am grateful to Cary Brown, Nick Stern, and Jim Poterba for helpful comments, to Doug Galbi for research assistance, and to the National Science Foundation for financial support.

# Integrating Allocation and Stabilization Budgets

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This conference simultaneously honors the memory of Joe Pechman, marks the retirement of George Break, and celebrates the 80th birthday of Dick Musgrave.

Joe was an immensely likable and friendly person as well as an outstanding member of the profession. While primarily interested in policy, he conveyed a basic respect for the role of theoretical research in the development of policy. This was very reassuring for someone who wanted to do basic theoretical work and wanted to be policy relevant. Joe fought the good fight for all of us. We miss him sorely.

George was a senior member of the department when I began teaching here at Berkeley. Of George's many writings, his work on intergovernmental relations, 1967, was the work I knew best and admired most. If preparation time for this conference had been sufficiently long, that work would loom large in my presentation, since I believe that geographic variation in the level of aggregate activity is an important part of the design of stabilization policy[1]. Integrating allocation and stabilization issues would naturally require modelling intergovernmental relations and thus building on George's work. Berkeley will surely miss George after his retirement, for he was a good colleague. Like Joe, George gave me the feeling that what I enjoyed doing was worth doing - a feeling that is very welcome from a senior colleague in one's field. I

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[1] For analysis of stabilization on the state level, see Gramlich, 1987.

also appreciated being given the year long course for undergraduate majors, despite being the youngest of four faculty teaching public finance. The learning coming from teaching is frequently extolled, but for a new assistant professor fresh out of graduate school, this was the perfect teaching experience.

And, of course the graduate education which I was trying to distill, extend, and teach to undergraduates was primarily the study of the <u>Theory of Public Finance</u>. In the spring of 1961, Cary Brown led a troop of us through the book. I still have the mimeographed correction sheet we had (and added to). My favorite was "Substitute small absolute fall for large absolute rise (page 546, line 5 from bottom)". This could only have been the work of gremlins. <u>Theory</u> was the book that put public finance squarely in the general equilibrium framework that has dominated the thought processes of economists. I was well prepared for this formulation by having been taught <u>Theory of Value</u> by Gerard Debreu at Yale in the spring of 1960. These two very different books were similar in their basic messages - to think about the economy requires a description of what happens in the entire economy. Dick's book set the intellectual environment in which many of us began doing public finance theory. As is often said, but generally less seriously meant, we were standing on the shoulders of giants.

<u>Theory</u> begins with the now familiar conceptualization of government activities by having separate budgets for the Allocation, Distribution, and Stabilization branches. As <u>Theory</u> makes clear, this division is for the purpose of conceptually organizing the subject, not because it is generally true that decisions in each of these areas can be simply decentralized. To use the conceptualization, the book proceeds, in part, on the basis that in analyzing one

branch, one can assume that the other branches are successful in carrying out their tasks. This division not only provided a good way to think clearly about individual policies, it formed a basis for building the then relatively new second best approach in a consistent manner. My own work on optimal taxation grew directly out of the general equilibrium formulation in Theory, contributing to the integration of allocation and distribution branches. In this paper, I want to speculate on how development of the micro foundations of macro might lead to a similar integration of stabilization and allocation branches. I will present some ideas about pieces of such an integration, partially in terms of simple models to illustrate the possibility of such formal development. I will focus on real models and then say a little about inflation.

As George and Joe wrote in their wonderful book (1975), "Regardless of whether one tends to favor passive neutrality or active optimization as the proper goal of a good tax system, the nature and size of its effects on the allocation of resources are important aspects of its performance." (page 8.) The spirit of this conference is to build on the conceptions of these three in pointing to research directions that might be fruitful.

## I Looking Back - Optimal Taxation

From the perspective underlying the use of three separable budgets, there is no tradeoff between equity and efficiency; the government has sufficient powers to set the distribution of income as desired, without distorting any private decisions. This conclusion is obviously wrong. The problem for an analyst is to formulate a model which can generate insights into how the balance between equity and efficiency should be struck. This requires several ingredients. The model should have the property, either as an assumption or an implication of more basic assumptions, that it is impossible to change income distribution without affecting marginal decisions. The model needs to be a general equilibrium model. The model needs to be analytically tractable. For a start, it is generally handy for the model to have many of the properties of familiar models, so one can appreciate the implications of the new assumptions.

In the 1960s, the natural move to fit these criteria was to preserve the competitive general equilibrium model, but drop the ability to set lump sum taxes and transfers separately person by person. A poll tax (uniform lump sum tax) is obviously feasible (if one ignores riots in London). But a poll tax, while it destroys the link between the need for government revenue and the efficiency of private markets, does not affect the necessity of an equity-efficiency tradeoff. In order to operate on income distribution, one wants to combine the poll tax, presumably in the form of a poll subsidy, with distorting taxes to finance the subsidy. (One can imagine models where the income distribution question is primarily related to certain goods (e.g., medical services) so that one uses a poll tax to subsidize medical care.) This combination of assumptions - competitive general equilibrium, no lump sum taxes, poll taxes, and distorting taxes, whether linear or nonlinear - immediately leads to a model where it is impossible to get whatever equity and efficiency combination one wants and where, once a social welfare function is added, one can optimize on the efficiency-equity tradeoff.[2]

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[2] While this conception was important for the development of my writings in this area, the key analytical step initially was the realization that the use of the indirect utility function permitted a one consumer analysis to be interpreted as a many consumer analysis (Diamond and Mirrlees, 1971).

In this tradeoff, one is comparing the cost of distorting markets with the gain from redistributing income[3]. In the 1960s, the latter appeared straightforward, or at least familiar, while the former did not. The former required evaluating the distortionary impact of revenue raising in terms that could be compared with marginal redistribution gains. The simplest model for describing the cost of revenue generation by distorting taxation was (and is) a one consumer model. And so the route into understanding the equity-efficiency tradeoff was through the minimization of distortion in a one consumer economy. This route, or detour, if you will, had unfortunate implications for the reception of this approach to the basic public finance question. The approach was attacked as ignoring income distribution. Yet the route seemed to me to be the best (probably seemed to me as the only) way to make sense of the limits on income redistribution. The purpose of this aside was not to defend past work, but to set up a parallel for the stabilization discussion to follow.

## II Looking Ahead - Optimal Stabilization

I want to pursue the analogy for stabilization of the optimal taxation approach to distribution. Let us start with the same obvious point. Just as it is impossible to redistribute income perfectly, it is impossible to stabilize an economy perfectly. No one knows how to do it. Perhaps this is due to an inadequate set of tools. Perhaps it is only a failure of research to date. It was easy to see what assumption needed dropping from competitive general equilibrium theory to have an interesting second best income distribution

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[3] With this formulation, it is easy to see that the envelope theorem implies that, generically, the optimum includes some distorting taxes unless income distribution can not be improved, even by lump sum taxes.

problem; it seems hard to find a similar move that will feel right for stabilization. What we want is a stabilization problem that represents a tradeoff, for that is what we think we have[4]. Macroeconomists pose this problem in terms of the tradeoff between unemployment and inflation[5]. I want to pose this question in terms of a tradeoff between efficiency and stabilization, whatever that may mean. I will have in mind three different types of circumstances. One is a prolonged period of low output, the second is a large identifiable shock, the third is demand uncertainty. That is, I will consider three different public finance questions that arise in these three different contexts. The use of these different contexts makes clear that our notion of stabilization covers a wide variety of different problems.

It is a natural research strategy to proceed in two steps - to ask whether the question can be posed in a totally real model, and then to have a model with nominal values, and so some of the issues that surround inflation. This seems a little crazy. (More than a little sometimes.) But it may be no crazier than approaching income distribution via a one consumer model. I propose to consider some examples of what one might mean by incorporating stabilization and efficiency in a single real model (ignoring income distribution). Then, I will say a few words about inflation.

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[4] Conceivably some economists believe that constant money growth will solve all stabilization problems, as in the models of Robert Lucas (1972, 1989). I find it almost as hard to believe that some economists might think that as to believe this to be true about the economy. There is the possibility that constant growth is the best that can be done, just as one might conclude that a constant rate VAT is better than varying rates; but before one can address this possibility, one needs a model that has some realism in addressing the tradeoffs involving more complexity and more diversity.

[5] If it were adequate to think about allocation in terms of inflation and unemployment, it would be impossible to explain the enormous dissatisfactions with economies that have had zero inflation and zero unemployment.

A. Prolonged Low Output

I will start with a paper by Bob Haveman and John Krutilla (1967), which stayed in my memory for nearly 25 years because the premise seemed so right[6]. Consider a government investment. This will use, directly and indirectly quantities of labor spread over time. Some of the labor will be drawn from other employment; some from unemployment. The mix of sources will vary with the aggregate unemployment rate (and the location and choice of project). The correct shadow value of labor for cost benefit analysis should reflect this mix of sources, and so vary with the (forecasted) state of the economy as the project is built. The authors then went on to do some sample calculations based on alternative assumptions of the relation of the mix of sources to the unemployment rate and the relative shadow value of an unemployed worker. This paper has always seemed to me to point in the direction one wanted to go. Of course, it is only a piece of an integrated model. It says that if one is imperfectly stabilizing an economy, then there are implications for allocation rules. There is no model of why or how the economy is imperfectly stabilized or how public production affects use of other stabilization tools. As a corollary of that lack, there is no internal generation of the shadow values of employed and unemployed labor.

I do not know of a model which will simultaneously explain why unemployment rates remain at certain levels for extended periods of time either nationally or locally (the 30s, Europe in the 80s) and which will generate the needed shadow values and response derivatives. As a suggestion of how part of the model might go, I present an extension of a search equilibrium paper of

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6 Tracking down this paper required the serendipity of Bob Haveman's presence at this conference, since my memory was right on content, approximate date, and journal, but wrong on author.

mine (1982a)[7]. This is a partial-equilibrium steady-state model of the labor market. Thus, I am not considering the use of public projects to counter the typical business cycle. Rather, I am considering how the presence of the average level of unemployment should affect project evaluation, and how one might adapt project evaluation for extended periods of high unemployment. The supplies of workers and jobs are taken as given. Thus the animal spirits or forecasts that lead to one level of job creation rather than another is not modelled. Using a steady-state search model, one has an equilibrium unemployment rate, which will respond to the creation of government jobs[8]. Thus one can do analysis of the optimal response of public good production (in public jobs) to the level of private job creation (taken as given, possibly after optimal stabilization). It would be straightforward to replace the given level of private jobs by a given relationship between the level of private jobs and the level of public jobs. Then, one would analyse the optimal response of public good production to shifts in this relationship. By identifying public jobs with public goods, the allocation of jobs between public and private sectors includes an efficiency question. There is no significance in the assumption that public jobs produce public goods; a similar analysis could be done if public sector jobs produced a different private good or were simply less efficient ways to produce the same output.

We denote the supply of labor by L, the number of private and public jobs by K and $K^*$, and the number of filled jobs by E and $E^*$. When filled, a

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[7] For an approach to benefit-cost analysis based on fixed price equilibria, see Dreze, 1984.

[8] In a standard Keynesian macro model, employment is equal to labor demand. In a typical analysis of unemployment compensation, the response of employment to changes in policy parameters depends only on labor supply. Both of these can't be right. Probably, neither is. Search theory offers a framework that can be used for both questions.

private job generates a flow of y units of private consumption good. When filled, a public job generates a flow of $y^*$ units of public good. For convenience, we ignore income distribution and assume that consumption is equalized per capita. We also assume additivity in the instantaneous utility function and the same level of disutility whether working or searching, giving a flow of utility per person of $u(yE/L)+u^*(y^*E^*)$. Instantaneous utility is discounted at the rate r. Filled jobs exogenously break up with a separation rate s (viewed as a Poisson parameter). There is a matching technology which generates $M(E,E^*,L,K,K^*)$ and $M^*(E,E^*,L,K,K^*)$ newly filled public and private jobs[9]. This picture of the labor market will have a steady state equilibrium which satisfies

$$(1) \qquad sE = M(E,E^*,L,K,K^*),$$
$$sE^* = M^*(E,E^*,L,K,K^*).$$

Thus, social welfare of consumption is written as:

$$(2) \qquad W(E,E^*,L,K,K^*) = \int_0^\infty e^{-rt}[u(yE(t)/L)+u^*(y^*E^*(t))]dt$$

$$dE(t)/dt = -sE(t) + M(E(t),E^*(t),L,K,K^*)$$
$$dE^*(t)/dt = -sE^*(t) + M^*(E(t),E^*(t),L,K,K^*)$$
$$E(0) = E$$
$$E^*(0) = E^*.$$

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[9] For estimates of the aggregate matching function for the U.S., see Blanchard and Diamond, 1989, 1990a.

That is, we assume that the initial position of the economy has the steady state employment levels.

We assume that the investment to create a public job costs C in additive disutility[10]. Thus the first order condition for the optimal provision of public goods balances this cost C against the present discounted value of the induced change in public and private consumption. We are interested in how this balance varies with K. Calculating the derivative of the social welfare of consumption with respect to the creation of another public sector job starting at a steady state, we have the first order condition (see Diamond, 1980):

$$(3) \qquad C = \partial W/\delta K^{*} = r^{-1}(u'y/L,\ u^{*\prime}y^{*})((r+s)I-\partial \underline{M})^{-1}(\partial M/\partial K^{*},\ \partial M^{*}/\partial K^{*})'$$

where I is the identity matrix and $\partial \underline{M}$ is the matrix of derivatives of M and $M^{*}$ with respect to E and $E^{*}$. To see how the optimal number of public jobs varies with the number of private jobs, we calculate (3). In doing this, we must treat E and $E^{*}$ as endogenous variables given by (1).

The shape of the optimal tradeoff will depend on both the curvature in the utility functions and the nature of the matching functions. If utility functions were linear with equal coefficients on both types of employment and if jobs entered symmetrically in producing employment, then the optimal tradeoff between public and private jobs would be one-for-one, since welfare could be written in terms of their sum. For example, this would be the case if job matches were allocated in proportion to vacancies and vacancies entered symmetrically in producing matches:

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[10] This assumption is made for clarity of presentation, ignoring the important impact of public investment on jobs.

$$(4) \qquad M = [(K-E)/(K+K^{*}-E-E^{*})]f(E+E^{*},L,K+K^{*}),$$

$$M^{*} = [(K^{*}-E^{*})/(K+K^{*}-E-E^{*})]f(E+E^{*},L,K+K^{*}),$$

where f is an aggregate matching function.

In contrast with this case, we consider logarithmic utility functions and also a matching function reflecting a preference of workers for private jobs. The latter introduces an asymmetry in matching. Consider the process of recruiting workers as an urn-ball process. There will be a distribution across workers of the number of jobs about which they have heard. Assume that a worker only takes a public job if there is not a private job he or she can get[11]. Thus public jobs do not directly interfere with the filling of private jobs, although they interfere indirectly by decreasing the number of unemployed. (We ignore quits directly from one job to another.) With this approach, the matching functions are:

$$(5) \qquad M = b(L-E-E^{*})(1-\exp[-a(K-E)/b(L-E-E^{*})]),$$

$$M^{*} = b(L-E-E^{*})\exp[-a(K-E)/b(L-E-E^{*})](1-\exp[-a(K^{*}-E^{*})/b(L-E-E^{*})]).$$

Thus, the number of hirings for private jobs equals the fraction of workers ready to respond to a job offer who receive at least one private offer. This number is independent of the number of public jobs for a given level of unemployment. The number of hirings for public jobs equals the number of workers

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[11] For a discussion of the urn-ball approach to multiple applications for jobs and the derivation of the obverse of this matching function, see Blanchard and Diamond, 1990b.

ready to respond who receive an offer of a public job and no offer of a private job.

Figure 1 shows calculations of the optimal number of public jobs as a function of the number of private jobs (equation (3)) for two economies differing only in matching function[12]. The points marked * are the full optima assuming both jobs have the same costs, obtained by solving the first order conditions for private and public jobs simultaneously. The location of the full optimum and the slope of the tradeoff depend on the matching function, which affects the levels of private and public goods outputs as well as the extent to which more public good output comes at the expense of private good output. The upward slope of part of the locus shows some of the additional complexity that comes from having both allocation and stabilization issues - we are concerned with both the aggregate number of jobs and the division between sectors. Of course, the use of an infinite horizon steady state model is only a crude approximation to the richer model one would want, but it gives the flavor of an optimal response to periods of prolonged low private demand for labor.

B. Labor Demand Shifts

In the model sketched above there were too few or too many private jobs in total. No distinction was made among private jobs and no mechanism was described for influencing the number of jobs. I want to turn to reallocation now, considering a circumstance where there is a large increase or decrease in the value of output of some sector. One can think of peace breaking out. In

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[12] For this calculation, logarithmic utility functions were used, with the same coefficients on employment in both types of jobs. The symmetric matching function was taken to be Cobb-Douglas in unemployment and vacancies.

this case there will be a large movement of labor between sectors. Such movements can come when job creation either leads or lags job destruction. Assume that job destruction comes first. The process of moving labor between sectors is rife with externalities. There are the search externalities which are different in the two sectors. There is the desire to offset the bad income distribution impact of the shock (see, e. g., Diamond, 1982b). There is stickiness in wages which will affect both job destruction and job creation rates. There is the degree of foresight in job creation in the expanding sector. These issues leave lots of room for policies aimed at specific industries and workers, and for general policies which are not based on necessarily knowing the source of labor for a major expanding sector or the destination of labor from a major shrinking sector. That is, there is likely to be a role for aggregate policies in improving (presumably speeding) the adjustment to a recognized shock. For full modelling, one would want to include private adaptation to the presence of a policy of responding to recognized shocks.

C. Built-In Stabilizers

With the assumption that perfect stabilization is not possible, one is led to ask about the natural response of the economy to shocks. In this context the theory of built-in stabilizers plays a central role. In Theory, Musgrave models built-in stabilizers. Greater marginal tax rates lower the multiplier, making the economy less sensitive to some shocks. But greater marginal tax rates have greater distortions, lowering potential welfare. Thus there is a tradeoff that one could try to model consistently. Built-in stabilizers have two properties. One is that they have their effects quickly. The second is that they interfere with the circular flow which relates demand to production. The model I use to present such a tradeoff has a somewhat odd structure, being made of parts readily available in the literature; but my purpose is to raise researchable questions, not answer them. In particular, the circular flow is missing. The model in section A focused on lags in realizing allocation possibilities as the central aspect of the response to shocks. In this section, the focus is on commitments to particular prices which prevent some reallocations after certain shocks. The question we examine is whether the failure of markets to clear results is a higher optimal tax rate than with market clearance.

In order to consider built-in stabilization to respond to short run shocks, one obviously needs uncertainty somewhere in the model. There is already a literature on distorting taxation to provide insurance, paralleling the literature on optimal coinsurance. The new element being raised is the presence of macro failures. In other words, to what extent does the failure of markets to clear change the theory of optimal coinsurance[13]. In order to have nonclearing markets, I will use a model of fixed (real) prices, although I believe this is only part of the story of macro difficulties[14]. In large part, I am building on modelling ideas in Lucas (1989) that assumes fixed nominal prices and also on Salop and Stiglitz (1977) that uses a two price distribution.

When built-in stabilizers are used, the government deficit is a random variable. Thus the optimal use of built-in stabilizers must reflect a shadow

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13 In posing the question this way, I am naturally led to assume individual optimisation in the face of risk, ignoring the complications that come from failures to understand the workings of the economy.

14 I expect that an analysis of built-in stabilizers could also be built on the basis of finance constraints, for example, as modeled by Greenwald and Stiglitz, 1988.

value on the deficit carried forward in time. Built-in stabilization will only make sense if current revenues have a greater variation in shadow value than the deficit carried forward; otherwise it would not be optimal to have the deficit fluctuate in the way I will model it. I will duck the problem of intertemporal modelling by assuming that the government can transfer resources between two states of nature[15]. This should yield similar results. I will ignore possible restrictions on the complexity of built-in stabilization rules. Built-in stabilization is assumed to occur more quickly than prices are changed, with the need for incentives limiting the scope for stabilization. Serious development of this approach would need to model the available tax-transfer rules. Implicit in this model is the idea that changed command over resources is important, something not fully achievable by open market operations, which are exchanges of equal values.

There is a continuum of identical potential suppliers of good x. Each one can provide one unit at a utility cost c. The good will be traded for p units of good y. The utility of suppliers is v(p)-c. However, the production decision must be taken before the state of nature is known. We assume an infinitely elastic supply of good x. Therefore, the expected value of the utility of suppliers will be a constant, which we normalize to zero. Thus, we can ignore these suppliers in welfare calculations. It may be helpful to interpret these agents as workers and to interpret p as a real wage.

There is a continuum of suppliers of good y of measure one. There are two states of nature. If a supplier exerts no effort, output of that supplier is y in both states of nature. If a supplier exerts effort that costs e, out-

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[15] For another analysis of optimal taxation with separate states of nature, see Diamond and Mirrlees, forthcoming.

put of that supplier equals $y$ with probability $\pi$ and equals $y'$ with probability $\pi'$, with $y<y'$. The occurrence of high output is perfectly correlated among suppliers exerting effort. It is assumed that it is socially worthwhile to induce effort by all suppliers; no mixed behavior outcomes are considered. This will be the incentive constraint for the government. Built-in stabilizers are assumed to work so quickly that the government can provide these suppliers with payments $z$ and $z'$ of good $y$ in the two states. This is done subject to the government resource constraint

$$(6) \qquad \pi z + \pi' z' = k,$$

for some constant $k$, possibly negative. These payments are made conditional only on individual supply, although these are perfectly correlated. No use is made of this perfect correlation to improve incentives. This restriction is made to avoid modelling idiosyncratic uncertainty that would prevent unrealistic use of this correlation. If a single supplier deviates from supplying effort, it is assumed that the transfer $z$ occurs in the good state rather than $z'$. Thus the level of $z$ must be low enough relative to $z'$ for suppliers to make the effort $e$. Having $z>z'$ corresponds to a positive marginal tax rate, while $y+z<y'+z'$ corresponds to a marginal tax rate below one.

The suppliers of good $y$ care only about the consumption of $x$, $u(x)$, and the effort to permit the good state to occur. Since the decision to supply $x$ is taken before the state is realized, consumption of good $x$ would not vary across states if the market allowing trade between $x$ and $y$ cleared. Thus, the optimal choice of $z$ and $z'$ would solve the problem:

(7) $\quad \text{Max} \quad u(x)$

$$\text{s.t. } \pi v((y+z)/x) + \pi' v((y'+z')/x) = c$$

$$\pi z + \pi' z' = k$$

$$\pi' u(x) - \pi' u(x(y+z)/(y'+z')) \geq e$$

The first constraint is that suppliers are willing to provide good x, which trades, in aggregate, for y+z units of good y in the bad state and y'+z' units of good y in the good state. The second constraint is the government budget constraint across states. The third constraint is that suppliers of good y provide effort. This makes it clear that total income must be enough lower in the bad state to induce effort. It is useful to define the prices that clear the markets:

(8) $\quad p^{*}x = y + z, \; p^{*\prime}x = y' + z'.$

The cost of providing good x comes from both the labor cost c and the risk aversion of suppliers. If there were no incentive problem for the suppliers of good y, public supply could be chosen to eliminate uncertainty for the suppliers of good x. That is, if we ignore the incentive constraint, the optimal solution has y+z equal to y'+z'.

We now examine the same problem under the assumption that the suppliers of good x must place a price on the good before realization of the state of nature. That is, we can think of workers committing themselves to particular real wages. It is assumed that demand is directed to the lowest price goods until all of demand is used up. (It would be appropriate to explore the more realistic case where some purchases are made at high prices even though low priced goods are available.) Thus suppliers of the quantity x will price their goods at p and sell in both states. Suppliers of the quantity x' will price at p' and sell only in the good state. In the labor market interpretation, the unemployment rate in the bad state is $x'/(x+x')$. Equality of purchases and sales now becomes

$$(9) \quad px = y+z, \; px + p'x' = y' + z'.$$

Thus, all of income is spent in both states. In order to induce these supplies of good x, the incentive must be adequate for suppliers setting both prices. Thus we have the supply constraints

$$(10) \quad v((y+z)/x) = c,$$
$$\pi' v((y'+z'-y-z)/x') = c.$$

That is, the low price goods are sold in both states at price p. The high price goods are sold only in the good state at price p'. The high price is enough above the low price to cover the loss from making no sale in the bad state. This structure would seem more natural if there were idiosyncratic shocks that supported the use of two different pricing strategies as well as the aggegate shocks being modeled.

It remains to describe the expected utility of and incentives for the y suppliers. In order to do this we need to determine which consumers get the low priced good in the good state. For simplicity, we assume that everyone pays the average price. Thus expected utility is now

(11) $\pi u(x) + \pi' u(x+x')$.

The incentive constraint is

(12) $\pi' u(x+x') - \pi' u((x+x')(y+z)/(y'+z')) = e$.

Optimal stabilization is now the maximization of (11) subject to (6), (10), and (12). For comparison with (7), we state the problem:

(13) $$\text{Max} \quad \pi u(x) + \pi' u(x+x')$$
$$\text{s.t.} \quad v((y+z)/x) = c,$$
$$\pi' v((y'+z'-y-z)/x') = c,$$
$$\pi z + \pi' z' = k,$$
$$\pi' u(x+x') - \pi' u((x+x')(y+z)/(y'+z')) \geq e.$$

To see the difference between these two problems, consider the case where both u and v are logarithms. The optimal z is simply the intersection of the government resource constraint and the incentive constraint for suppliers of good y. Thus in both cases we have

(14) $e/\pi' = \ln[(y'+z')/(y+z)] = \ln[(y'+(k-\pi z)/\pi')/(y+z)]$.

If it weren't for the incentive constraint, the government would increase z along the resource constraint. Even though government choice is the same in the two problems, the value of loosening the constraint is different in the two cases. With flexible prices, utility is ln(x) and the derivative of utility with respect to z along the resource constraint is

$$(15)\qquad \Delta = \pi(1/(y+z)-1/(y'+z')).$$

With fixed prices, the derivative of expected utility is

$$(16)\qquad \Delta' = (\pi+\pi'(x/(x+x'))/(y+z) - (\pi+\pi')(x'/(x+x'))/(y'+z'-y-z))$$

$$= \Delta + \pi/(y'+z') + \pi'(x/(x+x'))/(y+z)$$

$$- (\pi+\pi')(x'/(x+x'))/(y'+z'-y-z))$$

$$= \Delta + \pi/(px+p'x') + \pi'/(p(x+x')) - (\pi+\pi')/(p'(x+x'))$$

$$> \Delta.$$

Thus, while the discrete setup of this model resulted in the same government behavior with and without market clearance, the difference in the welfare costs of the incentive constraints in the two problems suggests that in a smoother model, one will have more insurance without market clearance. That is, the need for built-in stabilization will raise the optimal tax rate.

## III. Inflation

The models above were real. There was no allowance for the fact that transactions and contracts are in monetary units. Yet the stabilization branch needs to address significant average price level changes as well as unemployment. To the extent that one is willing to address this problem in a market clearing model, the analysis is less difficult. When one tries to incorporate the complexity of non market clearing along with the problems of average price changes there is greater difficulty. It is common in monetary theory to think about the price level clearing markets rather than thinking about individual price setting. It is also common to ignore the complexity that comes from shifting relative prices. If I were to survey the existing literature involving interaction between stabilization and allocation branches, I would probably start with the use of the inflation tax along with other distorting taxes as part of the optimal revenue raising structure (Phelps, 1972, 1973, Woodford, 1990), although one might not think of the choice of a steady inflation rate as a stabilization issue. But I want to focus on situations where prices are set by individuals, not fictitious auctioneers. Time limitations both before and during this conference limit the extent of my discussion here. I simply want to raise two points. One comes from recognizing that inflation comes from aggregating many price changes. The second comes from interactions between inflation rates and market power.

A. Price Adjustment Costs

I find it unlikely that the resource costs of changing prices play a significant role in the slow erratic way in which prices respond to economic conditions. Nevertheless, as an example of the sort of second best analysis I have in mind, consider a two good model where the cost of changing prices is the only reason for not achieving the Walrasian optimum. The model is in continuous time. There is a constant labor supply of one which can be continuously and costlessly reallocated between production of two nondurable goods. There is an additive disutility, $z_i$, whenever consumer price i is changed. Pricing is done by a central planner. There is a representative consumer. We denote the vector of consumer prices in money terms by q and the vector of producer prices in labor units by p. Wages are paid in money, which is then spent to purchase consumer goods. Thus instantaneous utility from consumption can be written as v(q(t),I(t)). The demand vector, x(q(t),I(t)), must satisfy the production constraint

(15) $p(t)x(q(t),I(t)) = 1.$

Assume that the exogenous values $p_i(t)$ are exponential with different rates. The government wants to set prices and income to maximize the discounted integral of v less the discounted sum of costs of price changes.

Since only relative prices of consumer goods matter, there is no reason to change both prices, just the one with the lower cost of adjustment. Thus, in a two good model the optimal (average) inflation rate might be positive or negative, but, except at the knife edge of equal adjustment costs, not zero[16]. This extreme finding goes away with more goods, but zero has no special claim for presumed optimality. Obviously, optimization of both prices and incomes still leaves a second best problem.

B. Market Power

The discussion above focused on the cost of adapting to change, assuming a socially optimal adaptation. In addition to socially optimal adaptation, one needs to consider nonoptimal adjustments to different inflation rates. In part, these come from the extent to which people do not perceive or understand

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[16] Contrast this approach with the view that higher inflation involves a cost of more frequent price changes (e. g., Fischer and Modigliani, 1978).

the differential impact of different inflation rates[17]. I will say nothing about this, since I know no evidence about the extent to which people fail to understand the pricing process in the economy, and I know little theory to substitute for direct evidence. A second element is the way in which different inflation rates interact with market power; that is, the extent to which the deviation of the market outcome from some optimum varies with the average rate of inflation. For example, I have been told by Israeli friends that at sufficient inflation rates it becomes impossible to comparison shop, cutting competition. It is natural to capture this idea in a search model. Search models with inflation have been constructed by Benabou (1988, 1989), by Casella and Feinstein (1990), and by me. For personal convenience, I will discuss my own model.

When firms price on a take it or leave it basis and it is costly to seek out alternatives, there is some degree of market power. The presence of inflation and sticky prices will affect the degree of market power in equilibrium. Thus, as with taxes, the interaction between inflation and market power is important for evaluating different inflation rates. In my (1989) paper, in the absence of inflation, market power extracts all of consumer surplus from shoppers, while free entry implies a lack of profit for firms. Thus inflation, which cuts into market power by having in place previously priced but not yet sold goods improves welfare. A similar finding holds for deflation (Diamond and Felli, 1990). With all consumers identical, zero inflation is the worst possible outcome. In the work of Benabou, it is also true that

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[17] Consider the greater apparent willingness of the American publid to accept cancellation of social security cost of living adjustments than to accept benefit cuts. Consider contracts in nominal terms that do not change as inflation rates vary, such as the maximum pay cut for baseball players without free agency under the major league basic agreement.

the interaction of inflation and market power implies that inflation has beneficial effects at sufficiently low rates.

Neither my discussion of individual price setting, nor of general inflation has a strong fiscal flavor. It would be nice to integrate inflation into fiscal analysis by recognizing the differential inflation effects (in timing and perhaps level) of different taxes[18]. This is a familiar concern in countries contemplating removal of large subsidies because of revenue needs. Moreover, it was present in discussions in the US in the 70s. However, I have never seen a balanced budget incidence analysis. What would happen if one were to systematically increase consumer goods subsidies, financed by rising income taxes? Presumably the distortions that come from imperfect taxes and subsidies would overwhelm the gains from decreased inflation at some point. But would such a policy make sense on a one time basis? While I am not enamored with the idea, it seems a question that can lead into a useful analysis. It might serve as a framework for evaluating the TIP proposals that were so popular and will probably return to the public discussion again.

Growing understanding of a range of non-Walrasian models holds considerable long run promise for improving resource allocation when it is combined with the serious use of theory in policy analysis. Such a future would mark a continuation of the pattern so wonderfully exemplified by the three public finance economists we honor today.

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